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THE SUBLINGUA AND THE PLICA FIMBRIATA. By FREDERIC
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THAT the curious structure known as the sublingua in the Lemurs should be the expression of any very primitive condition is an assumption which, though commonly made by comparative anatomists, is not likely to impress anyone who is familiar with the habits of Lemurs as being at all probable.

If one were asked to point to a peculiarly highly-specialised structure, one that had been definitely elaborated in response to a functional need, it would be difficult to select a feature more satisfying than the lemurine sublingua. This curious structure is one that cannot rightly be understood by studying it merely as a fold upon the under surface of the tongue; it must be correlated with other details of the anatomy of the mouth and must be observed in the living animal. The incisor teeth of the typical Lemurs are peculiar; the lower ones being strikingly elongated and set at such an angle in the jaw that their "biting" edges face directly forwards instead of being directed upwards towards the upper incisors.

Moreover, it is evident that these peculiar lower incisors have some function which is not shared by the upper incisors, for the incisor series of the upper jaw is composed of somewhat rudimentary peg-shaped teeth which are evidently not exercising their full functional rôle. They are not engaging the lower incisors in any action of biting, and in adult skulls they are very commonly in an extremely reduced condition. More than this, the lower incisors are reinforced by the lower canines which, assuming the same elongated form, become procumbent with the incisors, and are at times mistaken for members of the incisor series.

Following upon this change in the lower canines, the first lower pre-molars have assumed the rôle and form, but not the position, of true canines, and have added to the confusion produced in the minds of some who have dealt with this question (see fig. 1). This curious arrangement of the lower incisors and canines is a very striking one, and there can be no question as to its purpose, since these teeth play little or no part in the

process of alimentation, but are specialised purely as a hair comb. So far as I know, this function was first detected by Cuvier, who, writing of *Lemur catta*, said that the lower incisor teeth "sont de véritables peignes" (*Hist. Nat. Mammif.*, 1829, p. 218). Hair combs and feather preeners have been evolved *de novo* time and again, and from a series of very different structures. There is no need to turn aside to the curious serrated claws of such birds as *Fregeta* or *Sula*; for a hair comb, which is also derived from the front teeth, is present so much nearer to hand in *Galeopithecus*. The dental hair combs of the true Lemurs and the so-called Flying Lemurs afford striking examples of parallel evolutions in response to functional demands, for though the end attained is the same

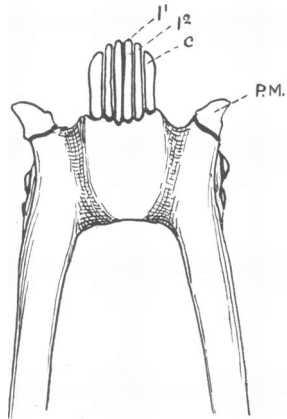


FIG. 1.—Anterior teeth of the lower jaw of *Lemur catta*, seen from below.

in the two cases, the method of making the comb is strangely different. In *Lemur* the incisors and the canines are ranged parallel and procumbent like the "teeth" of a comb; in *Galeopithecus* the biting edges of the individual incisor teeth have become finely serrated, and each tooth therefore furnishes many "teeth" for the comb; this method may be said to constitute an economy of incisors as hair combs, and the canines therefore do not join the incisor series, but on the other hand become modified in the direction of the molar series.

These two animal types have developed these dental hair combs probably for the reason that special adaptations have rendered it difficult to perform the toilet of the woolly hair by scratching—the Lemurs having no free claws upon the fingers and only one specialised one on the toes, and the limb of *Galeopithecus* being hampered by the flying membrane. In the case of the

Lemur the application of the hair comb is an oft-repeated business, and one that is very easy to observe in all its details.

With the development of this very highly-specialised dental structure there has arisen a need for specialised toothbrushes, and again it is of interest to note that the two forms have evolved entirely different forms of organs for this purpose. In *Galeopithecus* the anterior edge of the tongue is finely serrated in harmony with the serrated incisors, a very efficient toothbrush being provided for the hair comb. *Lemur*, on the other hand, has developed some structure beneath its tongue into a horny leaf-like organ which is finely serrated along its edges and sharp-pointed at its tip (see fig. 2). The use of this structure as a toothbrush has, I believe, been

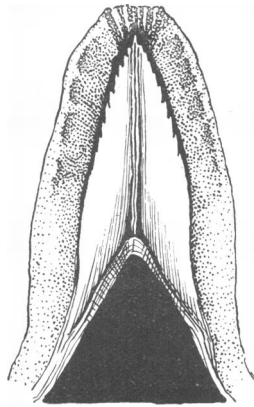


FIG. 2.—Tongue of *Lemur catta*, seen from below, to show the plica mediana and plicæ fimbriatæ.

long familiar to Mr R. I. Pocock, and there can be no doubt whatever that the “sublingua” of *Lemur* is a purely functional organ, evolved from some part of the tongue for the purpose of cleaning the functionally specialised lower incisor teeth.

Such facts as these show the lemurine sublingua in rather a different light from that by which it is regarded as an inherited and functionless rudiment of some premammalian ancestral structure. But even though it is in *Lemur* a functional, highly-developed, and specialised structure, it is of necessity made from some basis which other mammals must possess in some degree. This basis is a curious one, and one that is so variable in its manifestations that its most primitive expression in the mammals must remain somewhat uncertain.

Nevertheless, one particular basal type appears to embrace all the

modifications so far met with, and that will be described provisionally as the ideal form.

This form finds expression in certain Marsupials, a few Eutherian adults, and several Eutherian embryos.

In this type, the tongue bears no papillæ whatever upon its under surface. There may or may not be a median strengthening elevation extending from base to tip; but upon either side of the middle line, starting near the middle line at the free tip and diverging as they proceed backwards, are folds with projecting edges which are covered by thickened horny epithelium. The free edges of these folds may be variously serrated. At the attached base of the tongue they turn forwards and downwards towards the floor of the mouth as two crenated folds that terminate

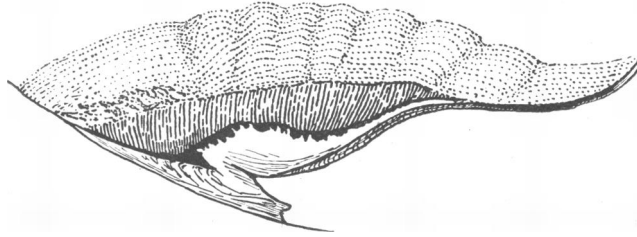


FIG. 3.—Tongue of *Petaurus breviceps*. The continuity of the plica fimbriata with the plica sublingualis is well seen.

near the middle line of the floor of the mouth not far behind the symphysis menti.

At the point where the fold upon the side of the tongue curves forwards to join the fold on the floor of the mouth a common fold runs backwards along the attached margin of the tongue and here becomes gradually lost (see fig. 3). In many cases it would probably be more correct to describe this last fold as running along the side of the posterior portion of the tongue and floor of the mouth, subsequently bifurcating into one fold which runs along the side of the tongue, and another which runs along the floor of the mouth. Any or all of these folds may be finely serrated, more coarsely dentated, merely crenated, or practically plain. Since the lemurine toothbrush is an elaboration of the fold upon the free portion of the tongue, it is natural to inquire if the whole basal structure may not have some such function, and that this is the true explanation of the presence of these folds appears to be extremely probable. Such a view is strengthened by the fact that their development is certainly not an isolated thing, for upon the outer side of the dental series an exactly similar serrated fold is, in many animals, produced from the lower lips

and cheek folds. This curious fold is well seen in the dog, and, so far as I know, no purpose has ever been ascribed to it; but I believe its true rôle is a cleanser of the teeth, and that the same service is performed within the mouth by the folds which lie below the tongue. It must be remembered that, although in *Homo* the tongue may explore and cleanse the whole dental series, the relation of the tongue, teeth, and floor of the mouth forbids a lingual exploration of the molar series in many animals. In the new-born Palæarctic wolf figured (fig. 4) the condition is very remarkable, for here the labial folds outside the dental series are associated with serrations of the side of the tongue within the dental series. This is another lingual toothbrush, which, as in *Galeopithecus*, is not formed from

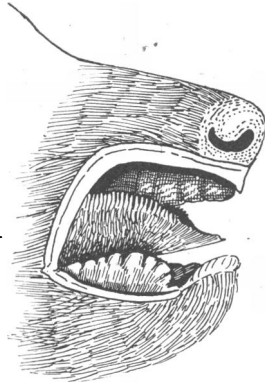


FIG. 4.—New-born cub of Palæarctic wolf with cheek removed, to show the lip fold and the dentated side of the tongue.

a fold beneath the tongue but by the papillated surface of the tongue itself. Although I gather from Professor Wright that the use of the tongue as an organ for cleansing the teeth had impressed Leonardo da Vinci and had prompted him to some speculations upon this very point, it must be confessed that this aspect of the tongue as a functional structure has subsequently become rather overlooked.

In order to follow the fate of the specialised folds which lie below the tongue it is necessary to adhere to a precise nomenclature, and reference will be made again to a tongue such as that of *Petaurus breviceps*, which appears to show all the folds in fairly full development (see fig. 3).

The median strengthening rod is known as the *plica mediana*, and it is an expression of a sublingual development of the septum of the tongue. It is an extremely variable structure. The midline of the under surface of the tongue may be elevated, flattened, or depressed, for the

thickening of the septum as a supporting structure may take place within the substance of the tongue or below its inferior surface. In *Petaurus* it is a well-marked free ridge upon the under surface of the tongue. It is this structure which finds one form of expression in the "lyssa" or

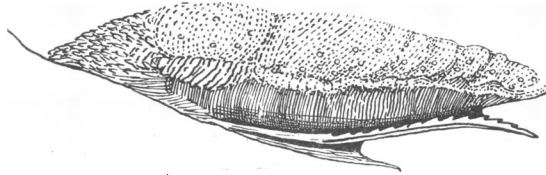


FIG. 5.—Tongue of *Lemur catta*. The plica fimbriata forms the well-developed sublingua. The plica sublingualis has practically ceased to exist.

"tollwurm" of the dog's tongue. In *Lemur* it constitutes the median ridge of the "sublingua."

The fold which runs from the tip of the tongue towards its attached base is the *plica fimbriata*, and the fold which runs from the posterior portion of the tongue to the floor of the mouth beneath the tongue is

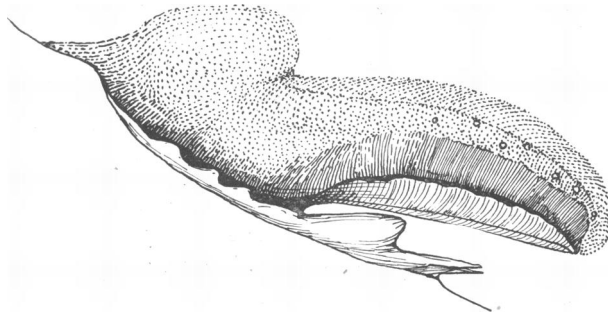


FIG. 6.—Tongue of *Tarsius spectrum*. Plica mediana, plica fimbriata and plica sublingualis are all well developed.

the *plica sublingualis*. This fold at its anterior limit in the floor of the mouth marks the site of the openings of the submaxillary salivary gland, and may be reduced to a structure no more prominent than the so-called Wharton's papilla or caruncula.

The present paper is concerned simply with the comparative development of these folds within the limits of the order Primates, as that order is at present constituted.

In the *Lemurs* the characteristic features are determined by a great

development of the plicæ fimbriatæ, which constitute a highly-specialised organ adherent to the tongue over the great extent of its length and supported in the middle line by the plica mediana. This structure composes the "sublingua" of the Lemurs. The tip of the sublingua is

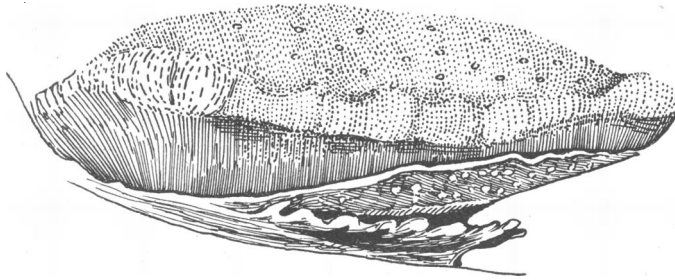


FIG. 7.—Tongue of an adult Chimpanzee. Plica fimbriata and plica sublingualis both well developed.

free of the under surface of the tongue for a short distance. In all the Lemurs the plica sublingualis is an extremely rudimentary structure, entirely wanting upon the side of the tongue, and represented merely by minute carunculæ on the floor of the mouth.

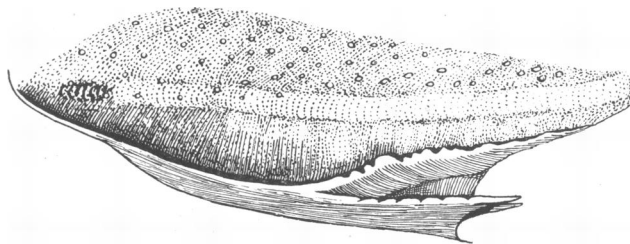


FIG. 8.—Tongue of a human fœtus. Plica fimbriata and plica sublingualis are both well developed.

The development of the plica mediana and a conspicuous "sublingua" derived from the plicæ fimbriatæ upon a somewhat lemurine model is seen in the Didelphia in *Trichosurus vulpecula*, but in this type the plica fimbriata is by no means so highly specialised as it is in Lemur.

The tongue of *Tarsius* stands in very marked contrast to anything seen in the Lemurs, for here all those parts which we have pictured as being components of the generalised condition are fully developed (see fig. 6). The plica mediana is strongly marked. The plicæ fimbriatæ occupy a relatively large area of the under side of the tongue, and they

are adherent to it in the whole of their length. The plica sublingualis is conspicuous, and shows a well-marked crenated edge. Histologically these folds show a well-marked thickening of the surface corneous layers such as is present in the almost horny "sublingua" of the Lemurs.

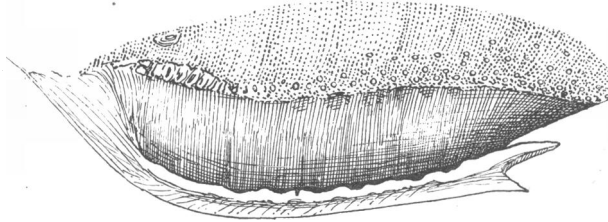


FIG. 9.—Tongue of *Macacus nemestrinus*. The plica sublingualis is well developed. The plica fimbriata has disappeared.

In the study of the interrelations of the different members of the order Primates the tongue of *Tarsius* is of the utmost importance, since no other members of the order save Man and the Anthropoids show this

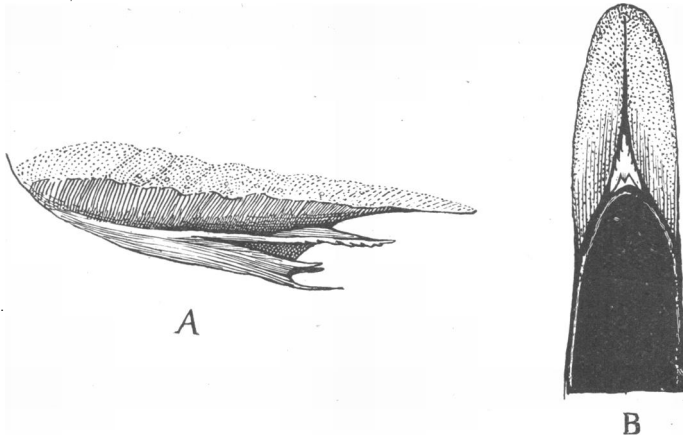


FIG. 10.—Tongue of a Marmoset (*Callithrix penicillata*). A, from the side ; B, from below. The plica fimbriata is well developed ; the plica sublingualis, though small, is large for a New-World monkey.

generalised condition of these folds. In the first place, it must be noted that the tongue of *Tarsius* differs entirely from that of any of the Lemurs in the possession of the plicæ sublinguales in a condition of full development, that it is of the generalised form, not widely different from that of *Petaurus*, a condition from which presumably the Lemurs have specialised

just as *Trichosurus* has departed in a somewhat lesser degree. In the train of *Tarsius* the tongues of the Chimpanzee (fig. 7) and of *Homo* (fig. 8) follow very closely, for in both types the two folds are well developed. But among the Primates they stand alone in this generalised condition, for all the monkeys of the Old World and the New are specialised in one direction or the other from this generalised form. In

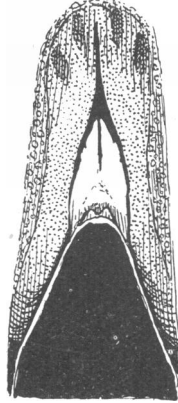


FIG. 11.—Tongue of *Cebus albifrons* from below, showing well-developed plicae fimbriatae and minute plicae sublinguales.

the Old-World monkeys the plica fimbriata is absent and the side of the tongue is entirely smooth, but the plica sublingualis is fairly well developed (see fig. 9). In the New-World monkeys the plica fimbriata is usually well developed and the plica sublingualis though present is not conspicuous (see fig. 11). In the Marmosets it attains a fair degree of development, but in other genera it is reduced to the merest rudiment (see fig. 10).

In none of the New-World monkeys, however, is the plica fimbriata developed into such a highly-specialised structure as the "sublingua" of the true Lemurs.